Econ 311: Behavioral and Experimental Economics

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Commitment

Motivation

- We have seen lots of evidence that people have time-inconsistent preferences
- How to we know that they are sophisticated, ie aware of their time-inconsistency?
- One answer: allow people to *commit* themselves to an action
  - This allows the present self to restrict the opportunity set of the future self
  - With time-consistent preferences this would make them worse off
  - But with present-biased preferences this restriction can be welfare improving

Example From Last Lecture

- Recall the example writing your paper over the next four weeks
- We showed that a time-consistent student would do paper right away, missing only the really bad movie
- Sophisticated time-inconsistent student would procrastinate somewhat
  - Go to really bad movie in first week
  - Do paper in second week, missing OK movie
  - Overall, they are worse-off then their time-consistent classmate, and they know this
  - Should be willing to undertake costly commitment to force self to do paper in first week, eg by having friend take away movie tickets if they don't do paper in first week
    - They are now as well-off as their time-consistent classmate

Procrastination and Deadlines

- Arielly and Wertenbroch (2002) run study with deadlines for assignments in a real class
  - Students have to write three short papers over course of semester
  - Penalty if don't turn in paper by deadline
  - Treatments assigned at the section level
  - Treatment 1: Fixed, evenly-spaced deadlines imposed
  - Treatment 2: Set own deadlines, can be any date before end of class
- Results:

Tying Odysseus to the Mast

- Ashraf et al (2006) design a commitment savings product for a bank in Philipines
  - SEED: Save Early Enjoy Deposits
  - Get 4% interest rate
  - Can't withdraw until either target month or target savings is reached
- Survey to collect hypothetical time preference questions of 1800 existing and former clients of bank
- Randomly offer commitment product to approximately half of sample
- Results:

Signaling to an Audience: Exley and Naecker (2015)

- Commitment technologies allow people to signal their intentions or goals to others with whom they have repeated interaction:
  - Their professor
  - Their banker
  - Their boss
- By experimentally manipulating the audience, can we change the demand for the commitment technology?

Exley and Naecker: Design

- Haas Center provides support and resources for student groups on Stanford's campus
- Runs regular workshops for development of student leaders
- Sign-ups occur online, days or weeks in advance
- Participants sign up for as many workshops as they want at once
- Commitment technology
  - After sign-up decision is made, one workshop chosen at random for intervention
  - Participant is immediately informed that if they attend this workshop, they will receive $15
  - If do not attend workshop, will receive $\$X$, where $0 \leq X \leq 15$
  - Participant chooses amount X
  - Payment will be made several days after workshops

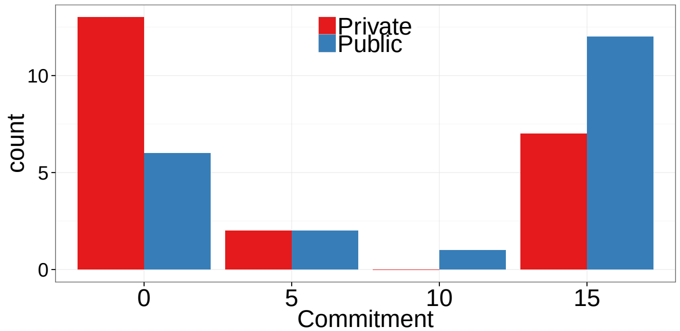
Exley and Naecker: Treatments

Private Student chooses X, and person running workshop is NOT informed of this value

Public Student chooses X, and person running workshop is informed of this value

- Predictions:
  - Define commitment $C = 15 - X$
  - Due to time inconsistency, we expect demand for commitment in both public and private treatments ($C_{pub} > 0$ and $C_{pri} > 0$)
  - Due to audience effect, we expect in addition that demand for commitment is stronger in public treatment ($C_{pub} > C_{pri}$)

Audience Effect is Significant



- When measuring time preferences, need to keep audience in mind

Modeling Commitment

Setting Up the Situation

- In period s, decision-maker (DM) allocates effort between two periods:
  - effort e_t in period t
  - effort e_{t+k} in period $t+k$
- Any tasks that are not completed at t are converted to tasks in period $t+k$ at a rate R
- Effort is costly: $c(e) = e^{\gamma}$ for $\gamma > 1$
- Decision made twice: once at period $s < t$ and once at period t
- Period s decision implemented with probability $p < \frac{1}{2}$, otherwise period t decision implemented
- Assume QHD, so discount function is given by

$$D = \begin{cases} \beta\delta^k \text{ if } k > 0 \\ 1 \text{ if } k = 0 \end{cases}$$

The Minimization Problem in Period s

- At period $s < t$, let choice of effort allocation be written as $e_{t,s}$ and $e_{t+k,s}$
- Then the discounted cost of that allocation is

$$\beta\delta^{t-s}e_{t,s}^{\gamma} + \beta\delta^{t+k-s}e_{t+k,s}^{\gamma}$$

- So the cost minimization problem is

$$\begin{aligned} \min_{e_{t,s},e_{t+k,s}} \quad & p\left[\beta\delta^{t-s}(e_{t,s})^{\gamma} + \beta\delta^{t+k-s}(e_{t+k,s})^{\gamma}\right] \\ & +(1-p)\left[\beta\delta^{t-s}(e_{t,t}^{s*})^{\gamma} + \beta\delta^{t+k-s}(e_{t+k,t}^{s*})^{\gamma}\right] \\ \text{s.t.} \quad & e_{t,s} + Re_{t+k,s} = m \end{aligned}$$

- $e_{t,t}^{s*}$ is the amount that the DM in period s thinks they will choose in period t

Solving the Period-s Minimization Problem

- Set up the FOC:

$$\begin{aligned} \frac{\partial\mathcal{L}}{\partial e_{t,s}} = 0 \implies \quad & p\beta\delta^{t-s}\gamma(e_{t,s})^{\gamma-1} = \lambda \\ \frac{\partial\mathcal{L}}{\partial e_{t+k,s}} = 0 \implies \quad & p\beta\delta^{t+k-s}\gamma(e_{t+k,s})^{\gamma-1} = R\lambda \end{aligned}$$

- Take the ratio to find the *Euler equation*:

$$\left(\frac{e_{t,s}^{*}}{e_{t+k,s}^{*}}\right)^{\gamma-1} = \frac{\delta^{k}}{R}$$

- Solution does not depend on the e^{s*} values, the probability p, or β

The Minimization Problem in Period t

- Now the DM arrives at time t and is asked again to allocate effort
- Minimization problem becomes

$$\begin{aligned} \min_{e_{t,t},e_{t+k,t}} \quad & p\left[(e_{t,s}^{*})^{\gamma} + \beta\delta^{k}(e_{t+k,s}^{*})^{\gamma}\right] \\ & +(1-p)\left[(e_{t,t})^{\gamma} + \beta\delta^{k}(e_{t+k,t})^{\gamma}\right] \\ \text{s.t.} \quad & e_{t,t} + Re_{t+k,ts} = ms \end{aligned}$$

Solving the Period-t Minimization Problem

- Set up the FOC:

$$\begin{aligned} \frac{\partial\mathcal{L}}{\partial e_{t,t}} = 0 \implies \quad & (1-p)\gamma(e_{t,s})^{\gamma-1} = \lambda \\ \frac{\partial\mathcal{L}}{\partial e_{t+k,t}} = 0 \implies \quad & (1-p)\beta\delta^{ks}\gamma(e_{t+k,s})^{\gamma-1} = R\lambda \end{aligned}$$

- Take the ratio to find the *Euler equation*:

$$\left(\frac{e_{t,t}^{*}}{e_{t+k,t}^{*}}\right)^{\gamma-1} = \frac{\beta\delta^{k}}{R}$$

- Thus the β acts as a wedge between the period-s optimal allocation and the period-t optimal allocation (since $e_{t,t}^{*} \neq e_{t,s}^{*}$)
- In particular, period t effort will be too low from the perspective of period s

Adding Sophistication

- Now suppose the DM is *sophisticated*
- In period s, the DM recognizes that in period t their decision will depend on present bias
- In particular, the period-s DM thinks that the period-t utility function will have present bias parameter $\hat{\beta}$
  - If $\hat{\beta} = \beta$, we call this *fully sophisticated*
  - If $\hat{\beta} \in (\beta, 1)$, we call this *partially sophisticated*
  - If $\hat{\beta} = 1$, we call this *naive*

Solving with Sophistication

- So what does the period-s consumer think the period-t choice of allocation will be?
- The DM thinks their future self will solve

$$\begin{aligned} \min_{e^s_{t,t}, e^s_{t+k,t}} \quad & p\left[(e^*_{t,s})^\gamma + \hat{\beta}\delta^k (e^*_{t+k,s})^\gamma\right] \\ & +(1-p)\left[(e^s_{t,t})^\gamma + \hat{\beta}\delta^k (e^s_{t+k,t})^\gamma\right] \\ \text{s.t.} \quad & e^s_{t,t} + Re^s_{t+k,ts} = m \end{aligned}$$

- We already know the solution to this will satisfy

$$\left(\frac{e^{s*}_{t,t}}{e^{s*}_{t+k,t}}\right)^{\gamma-1} = \frac{\hat{\beta}\delta^k}{R}$$

Adding Commitment

- Now we offer the period s DM a commitment technology
  - Change likelihood of period-s allocation being implemented from $p < \frac{1}{2}$ to $1 - p > \frac{1}{2}$
- What is expected cost without commitment?

$$\begin{aligned} C_n = \quad & p\left[\beta\delta^{t-s}(e^*_{t,s})^\gamma + \beta\delta^{t+k-s}(e^*_{t+k,s})^\gamma\right] \\ & +(1-p)\left[[\beta\delta^{t-s}(e^{s*}_{t,t})^\gamma + \beta\delta^{t+k-s}(e^{s*}_{t+k,t})^\gamma\right] \end{aligned}$$

- What is expected cost with commitment?

$$\begin{aligned} C_c = \quad & (1-p)\left[\beta\delta^{t-s}(e^*_{t,s})^\gamma + \beta\delta^{t+k-s}(e^*_{t+k,s})^\gamma\right] \\ & +p\left[[\beta\delta^{t-s}(e^{s*}_{t,t})^\gamma + \beta\delta^{t+k-s}(e^{s*}_{t+k,t})^\gamma\right] \end{aligned}$$

Commitment Choice

- When is the commitment choice the cost-minimizing one?
- Define the value of commitment at $V = C_n - C_c$
- Then we can show that

$$V = (1-2p)\beta\delta^{t-s}\left[\left((e^{s*}_{t,t})^\gamma + \delta^k(e^{s*}_{t+k,t})^\gamma\right) - \left((e^*_{t,s})^\gamma + \delta^k(e^*_{t+k,s})^\gamma\right)\right]$$

- If $\hat{\beta} = 1$ (ie naive), then indifferent about taking the commitment device (since $V = 0$)
- If $\hat{\beta} \in [\beta, 1)$ (ie sophisticated), we saw that the e^{s*} allocation leads to higher discounted costs than the e^* solution
  - Thus the sophisticated agent would put positive value on the commitment device (ie $V > 0$)